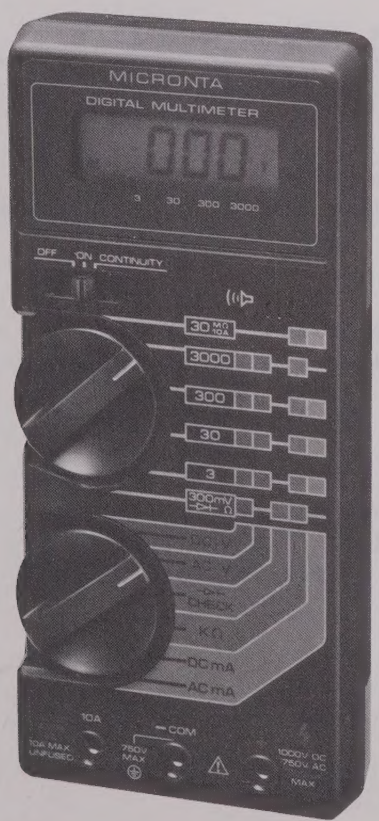
MICRONTA®

Service Manual

22-185

LCD
DIGITAL MULTIMETER

Catalog Number: 22-185



Electronic Services - Los Angeles
M13740X

CUSTOM MANUFACTURED FOR RADIO SHACK, A DIVISION OF TANDY CORPORATION

CONTENTS

	Page
SPECIFICATIONS	3 - 4
BLOCK DIAGRAM	5
GENERAL CIRCUIT DESCRIPTION	5
IC DESCRIPTION	6 - 7
OPERATION PROCEDURES	8 -14
AC/DC VOLTAGE MEASUREMENT	8 - 9
AC/DC CURRENT MEASUREMENT	10 -11
RESISTANCE MEASUREMENT	12 -13
CONTINUITY CHECK	14
DIODE CHECK	14
ALIGNMENT AND ADJUSTMENT	15 -16
TROUBLESHOOTING	17 -19
PCB DIAGRAMS	20 -21
ELECTRICAL PARTS LIST	22 -23
EXPLODED VIEW PARTS LIST	24
EXPLODED VIEW/DISASSEMBLY	25
TRANSISTOR LEAD IDENTIFICATION	26
SCHEMATIC DIAGRAM	27

NOTE: For disassembly, see Exploded View/Disassembly on page 25.

SPECIFICATIONS

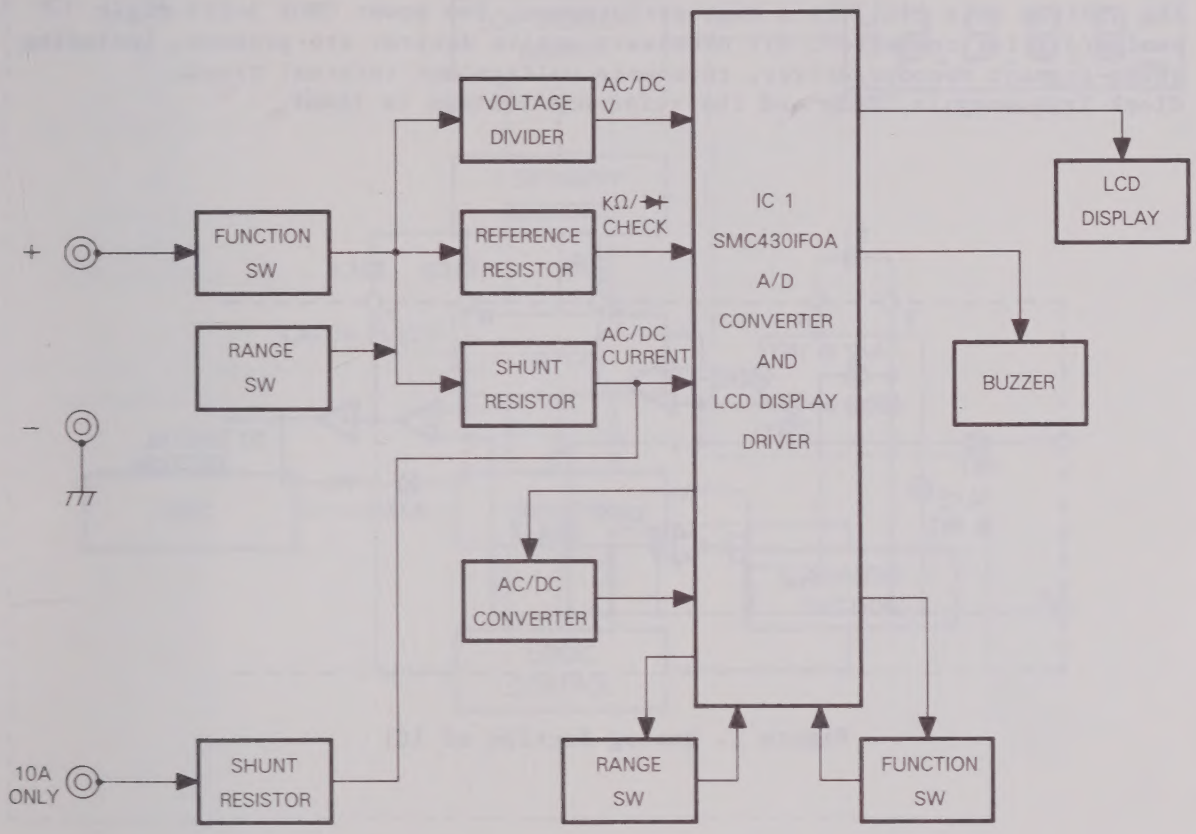
Display : 3 2/3 digit LCD

Accuracy	Nominal	Limit
DC Volts		
300mV-3-30-300-3000V (Maximum measurement = 1000 Volts)	±0.8% of reading and ±0.2% of full scale, ±1 in last digit	±1.0% of reading and ±0.2% of full scale, ±1 in last digit
AC Volts		
3-30-300-3000V (Maximum measurement = 750 Volts RMS) at 50/60Hz	±1% of reading and ±0.5% of full scale, ±1 in last digit	±1.5% of reading and ±0.5% of full scale, ±1 in last digit
45Hz to 500Hz at 30-Volt Range	±1.5% of reading and ±0.5% of full scale, ±1 in last digit	
500Hz to 10kHz at 30-Volt Range	±10% of reading and ±0.5% of full scale, ±1 in last digit	
DC Currents		
3-30-300mA-30A (Maximum measurement = 10A)	±1.5% of reading and ±0.2% of full scale, ±1 in last digit	±2.5% of reading and ±0.2% of full scale, ±1 in last digit
AC Currents		
3-30-300mA-30A (Maximum measurement = 10A)	±1.5% of reading and ±0.5% of full scale, ±1 in last digit	±2.5% of reading and ±0.5% of full scale, ±1 in last digit
Resistance		
300ohm-3-30-300 -3000kohm	±1.5% of reading and ±0.2% of full scale, ±1 in last digit +5 digit maximum at 300ohm	±2.0% of reading and ±0.2% of full scale, ±1 in last digit
30Mohm	±3% of reading and ±0.2% of full scale, ±1 in last digit	±5% of reading and ±0.2% of full scale, ±1 in last digit

Continuity Function	Continuity buzzer sounds with less than 295ohms (±20ohms) input resistance. Buzzer sounds 100ms-150ms (typical) after input is shorted.
Diode Check Function	Checks if diodes are open, shorted or normal.
Input Impedance	10Mohm (DC V/AC V). More than 100Mohm on 300mV DC
Range Selection	Manual range control
Power Source	Four "AA" size 1.5V Batteries
Power Consumption	10mW typical
Low Battery Indication	"BATT" on the left of display below 2.4V-2.6V
Polarity	Automatic polarity
Over Range Indication	3000 with blinking "3". When the measured value exceeds the maximum value, all digits on display will blink in DC V/AC V, DC 10A/AC 10A measurements.
Operating Temperature	32°F to 122°F (0°C to 50°C).
Storage Temperature	-4°F to 140°F (-20° to 60°C).
Weight	11.6oz. (330g) Approx.
Size	6-3/4" x 3-1/16" x 1-1/4" (170 x 78 x 32mm)
Accessories	Fuse 0.5A/250V Banana type test leads (Cat. No. 278-704)

NOTE: Nominal specs represent the design specs; all units should be able to approximate these -- some will exceed and some may drop slightly below these specs.
Limit specs represent the absolute worst condition considered acceptable; a unit should never perform to less than any limit spec.

BLOCK DIAGRAM



GENERAL CIRCUIT DESCRIPTION

The Micronta LCD Digital Multimeter operates around one IC.
The IC consists of a dual-slope A/D (Analog-to-digital) converter and a display driver.
It measures voltage only, so other measured parameters must be converted to voltage by the peripheral circuitry. To measure current, shunt resistors are used. To measure unknown resistance, a constant current is applied and the voltage is measured.

IC DESCRIPTION

The 4301FOA chip (IC1) is a high-performance, low power CMOS 3-2/3 digit analog/digital converter. All necessary active devices are present, including seven-segment decoder/driver, reference voltage and internal clock. Clock frequency is 32kHz and the reference voltage is 164mV.

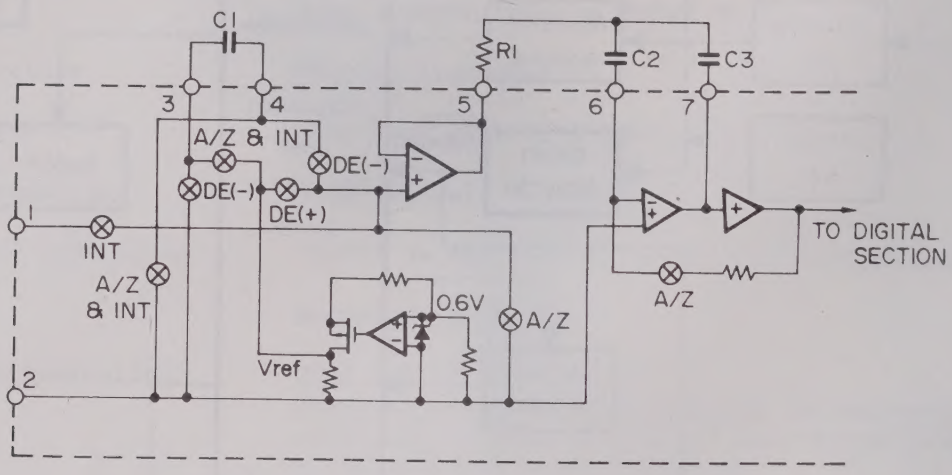


Figure 1. Analog Section of IC1

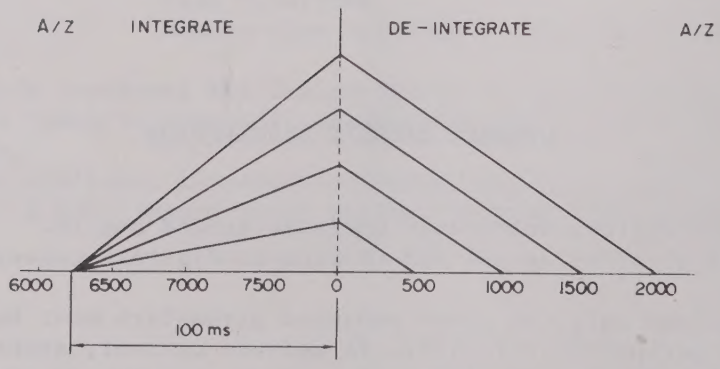


Figure 2. IC1 Operating Timing

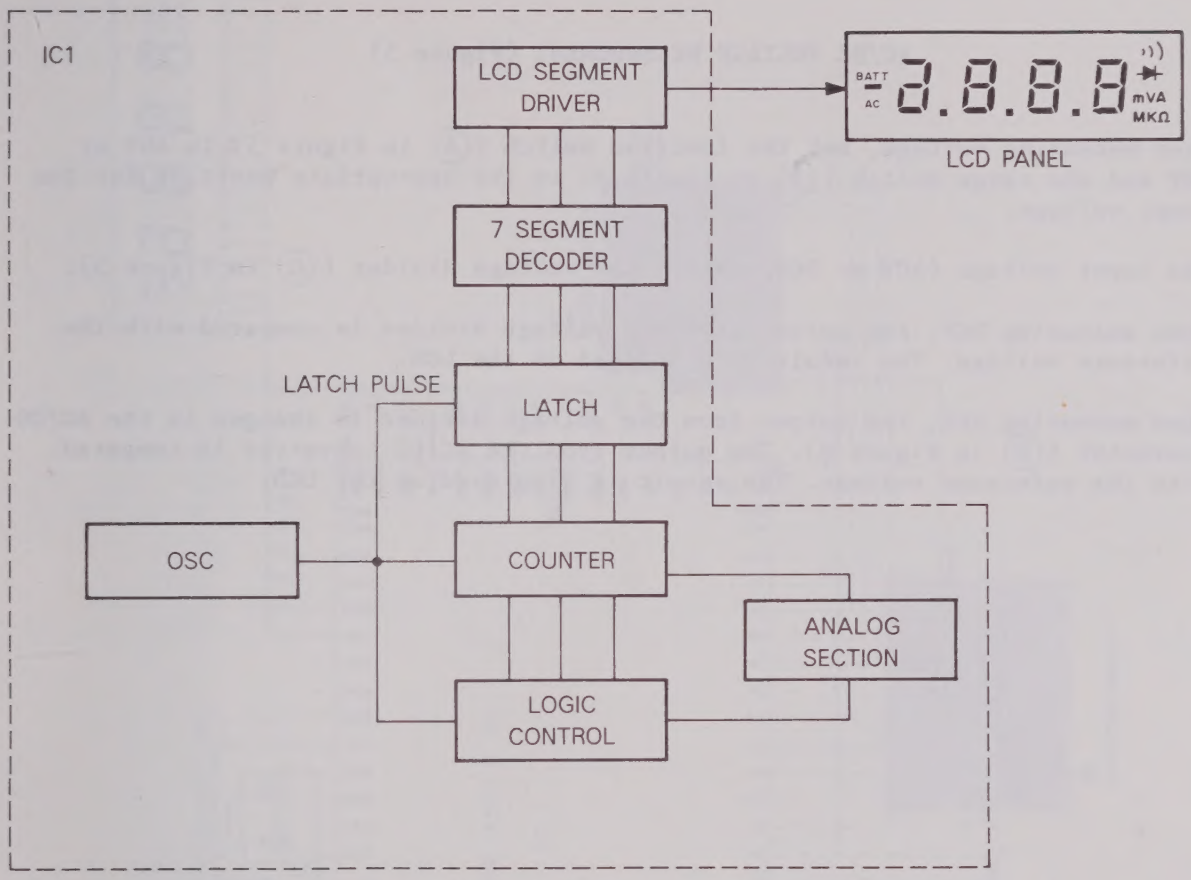


Figure 3. IC1 (SMC 4301 FOA) Block Diagram

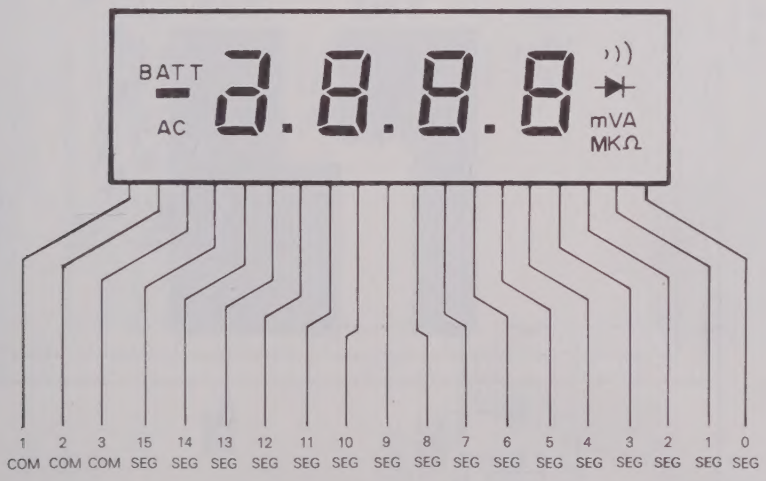


Figure 4. LCD PIN Configuration

AC/DC VOLTAGE MEASUREMENT (Figure 5)

When measuring voltage, set the function switch (Ⓐ in Figure 5) to ACV or DCV and the range switch (Ⓑ in Figure 5) to the appropriate position for the input voltage.

The input voltage (ACV or DCV) enters the voltage divider (Ⓒ in Figure 5).

When measuring DCV, the output from the voltage divider is compared with the reference voltage. The result is displayed on the LCD.

When measuring ACV, the output from the voltage divider is changed in the AC/DC converter (Ⓓ in Figure 5). The output from the AC/DC converter is compared with the reference voltage. The result is displayed on the LCD.

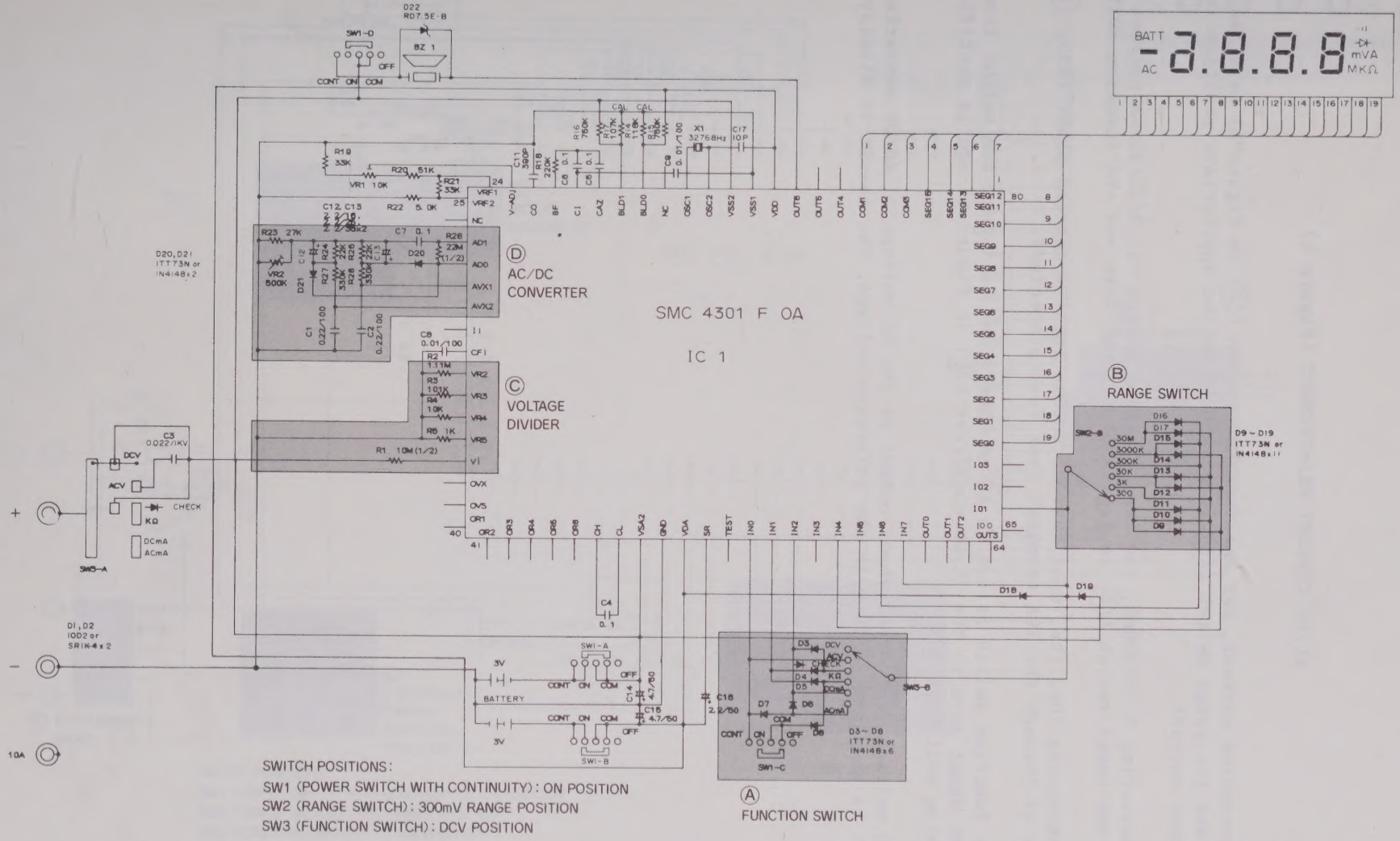


Figure 5. Diagram of DC/AC Voltage Check

AC/DC CURRENT MEASUREMENT (Figure 6)

When measuring current, set the function switch (Ⓐ in Figure 6) to AC mA or DC mA and the range switch (Ⓑ in Figure 6) to the appropriate position for the input current.

When measuring 3/30/300mA, the input current enters the 3/30/300mA current shunt and range switch (Ⓔ in Figure 6) through fuse and the function switch.

When measuring 10A, the input current enters the 10A current shunt (R33; Ⓕ in Figure 6) through the 10A terminal (not fuse-protected).

If the function switch is set to AC mA when AC mA is input, the output from the current shunt goes to the AC/DC converter (Ⓓ in Figure 6) and is rectified by an analog switch in IC1.

The DC voltage of current shunt output or the AC voltage of AC/DC converter output is compared in IC with the reference voltage. The result is displayed on LCD.

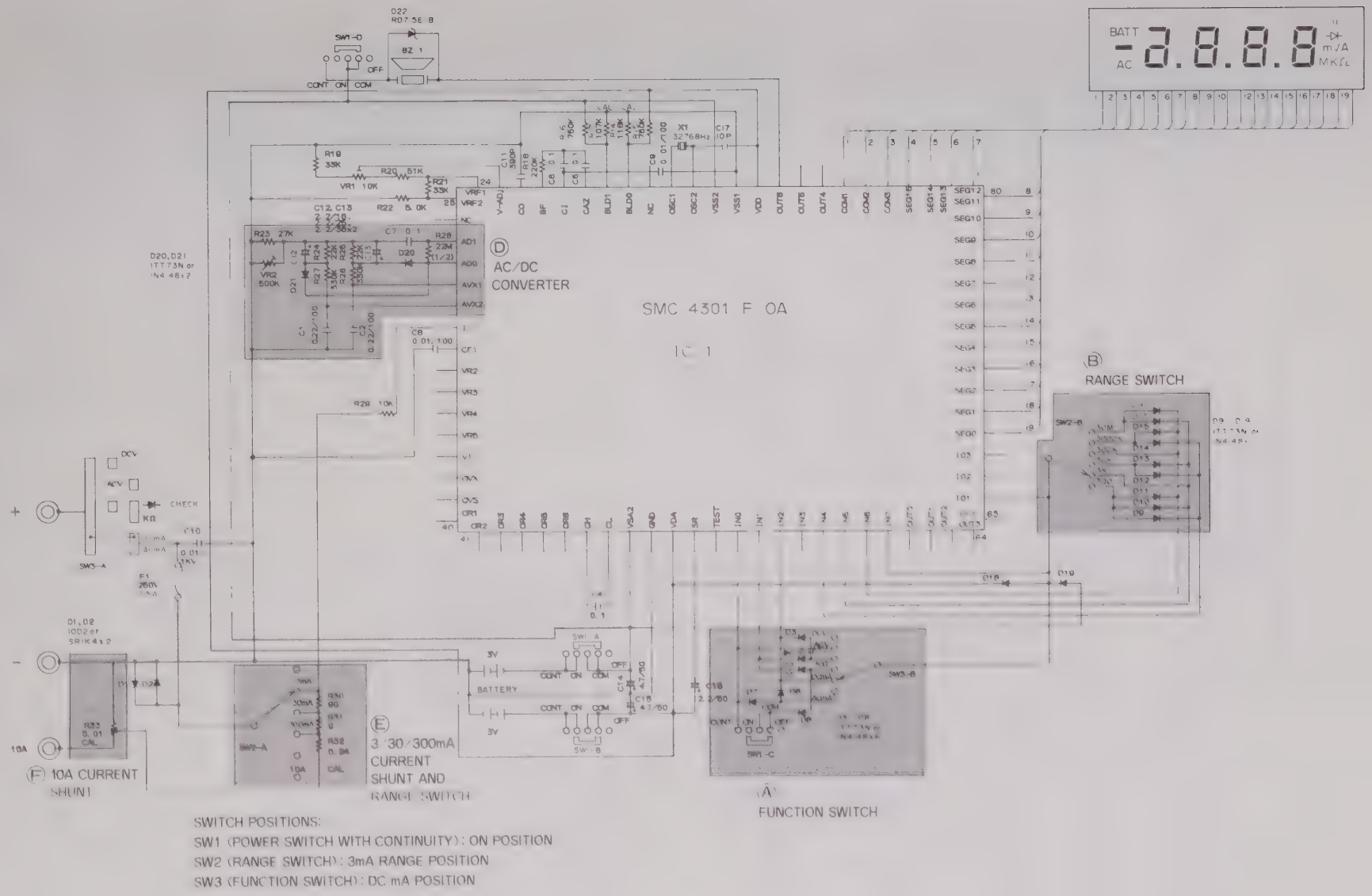


Figure 6. Diagram of DC/AC Current Check

RESISTANCE MEASUREMENT (Figure 7)

A ratio determines resistance. Set the function switch ((A) in Figure 7) to kohm and the range switch ((B) in Figure 7) as required for the resistance to be measured.

A series circuit is formed by the internal reference voltage, the selected reference resistors ((G) in Figure 7) and the resistance to be measured.

The ratio of the two resistors is equal to the ratio of their respective voltage drops. Since the value of the reference resistors is known, A/D converter calculates the value of the unknown resistor as follows:

In the case of integration:

$$V_o(INT) = \frac{Rx \text{ (Unknown Resistance)}}{Rref \text{ (Reference Resistor)} + Rx \text{ (Unknown Resistance)}} \times Vref$$

In the case of de-integration:

$$V_o(DE) = \left(1 - \frac{Rx}{Rref + Rx}\right) \times Vref = \frac{Rref}{Rref + Rx} \times Vref$$

$$\frac{V_o(INT)}{V_o(DE)} = \frac{Rx}{Rref}$$

P01 and Q1 constitute the protection circuit from over-voltage (500V AC 1 minute max.).

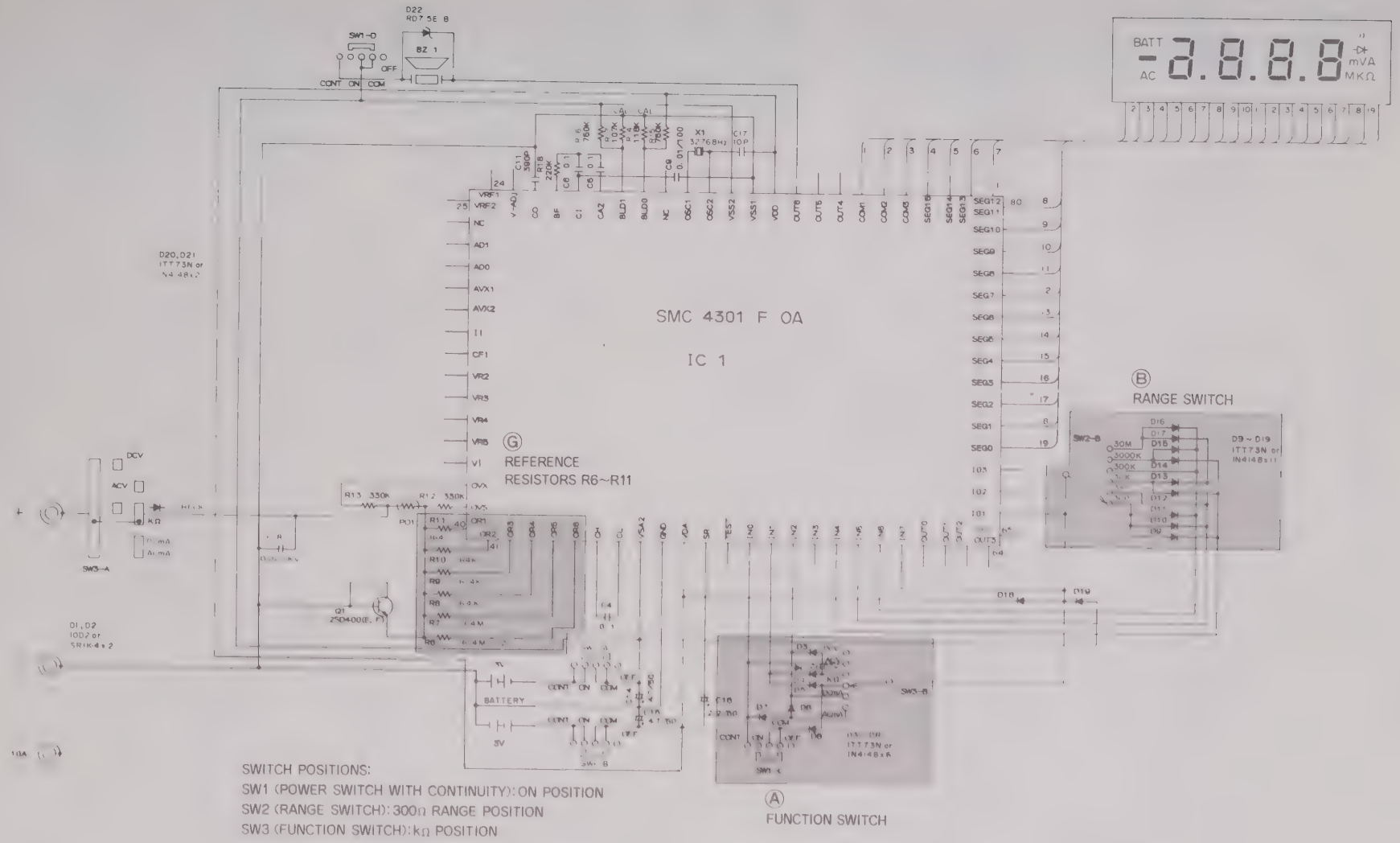

SMC 4301 F 0A
IC 1
Ⓖ REFERENCE RESISTORS R6~R11
Ⓑ RANGE SWITCH
Ⓐ FUNCTION SWITCH
SWITCH POSITIONS:
SW1 (POWER SWITCH WITH CONTINUITY): ON POSITION
SW2 (RANGE SWITCH): 300Ω RANGE POSITION
SW3 (FUNCTION SWITCH): kΩ POSITION

Figure 7. Diagram of Resistance Check

CONTINUITY CHECK

Set the power switch (SW1) to CONTINUITY and the function switch to kohm.
The range is held at 320ohm range and the oscillation circuit in IC1 operates.
The buzzer sounds if the value is less than 295ohms nominal.

DIODE CHECK

Set the function switch to diode check. Since open-circuit voltage between jacks is maintained at 3volts in the diode check function, you can check continuity of most diodes, LEDs and transistors, etc.
The display value during the diode check function is the forward voltage (2V max.).

ALIGNMENT POINTS

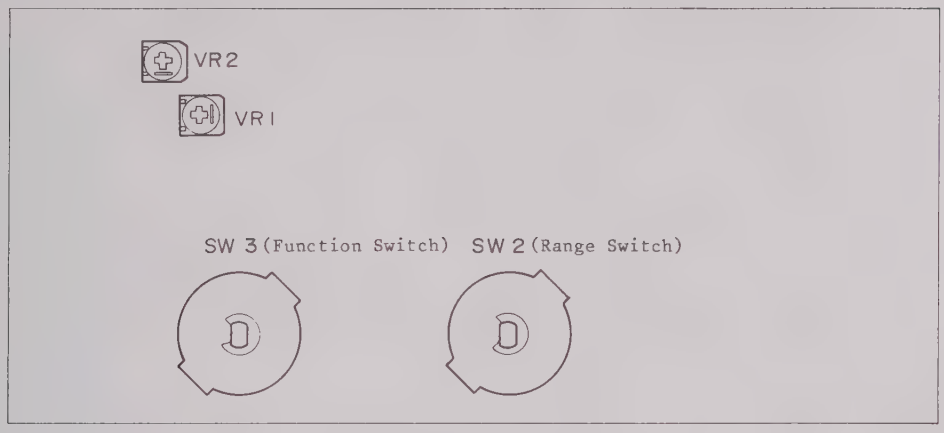


Figure 8. Calibration Points

EQUIPMENT REQUIRED:
1. AC Calibrator 0 - 750V (±0.1% accuracy, 100Hz - 1kHz)
2. DC Calibrator 0 - 1000V (±0.05%)
3. DC Current Calibrator 0 - 200mA (±0.2%)
4. Resistors 1kohm, 10kohm (±0.1%)

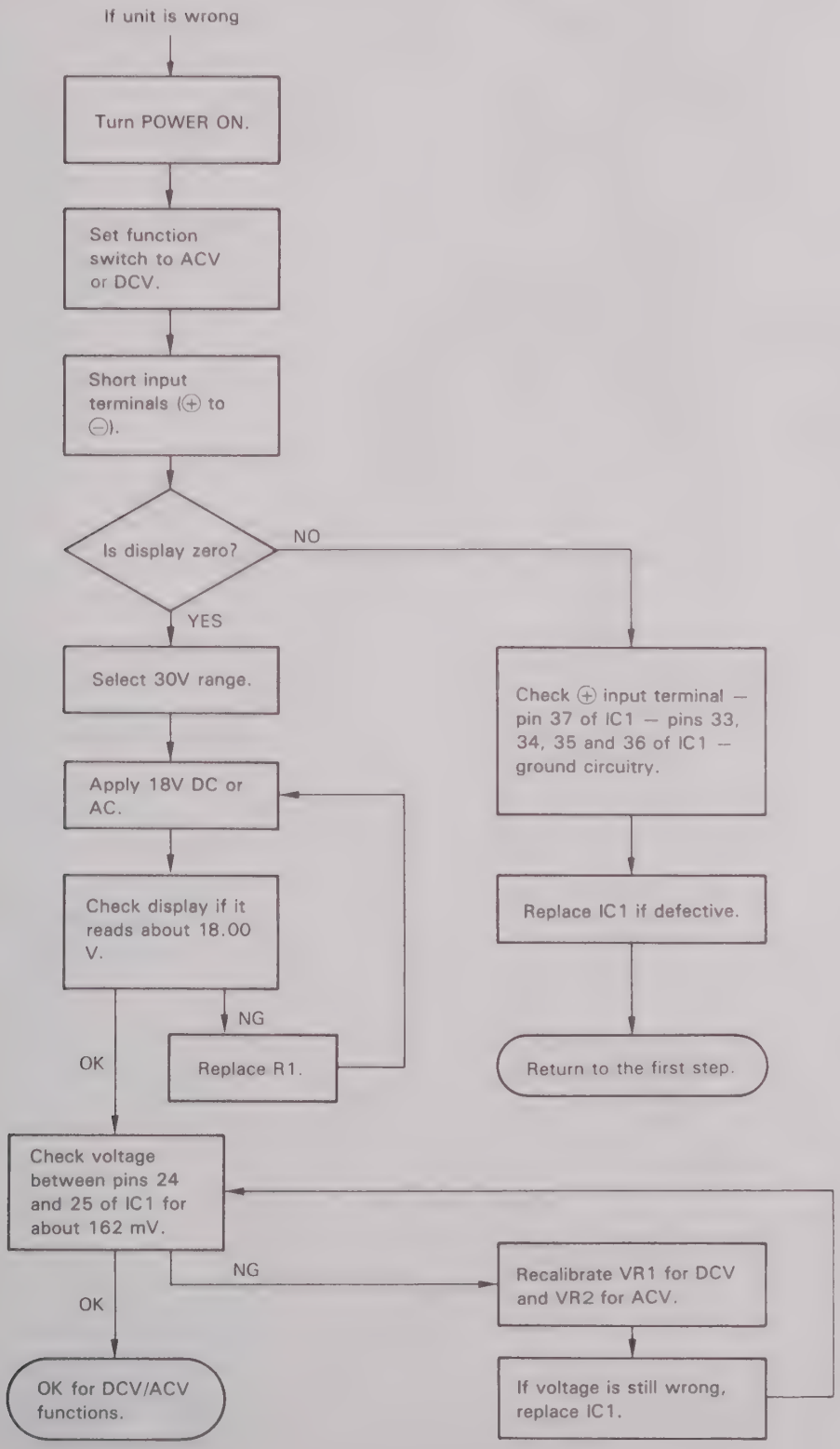
PROCEDURES:

STEP	CONTROL SETTING	CONNECTION & INPUT	ADJUST	ADJUST FOR
1	Set power switch to ON.			
2	**Alignment of DC Volgate Measurement Function**			
	Function Switch: DC V	1) Connect DC Voltage Calibrator. 2) Apply 2.800V DC to input.	VR1 (10kohm)	Adjust VR1 so the display reads 2.800.
3	**Alignment of AC Voltage Measurement Function**			
	Function Switch: AC V	1) Connect AC Voltage Calibrator. 2) Apply 28.00V AC to input (50 or 60Hz).	VR2 (500kohm)	Adjust VR2 so the display reads 28.00.

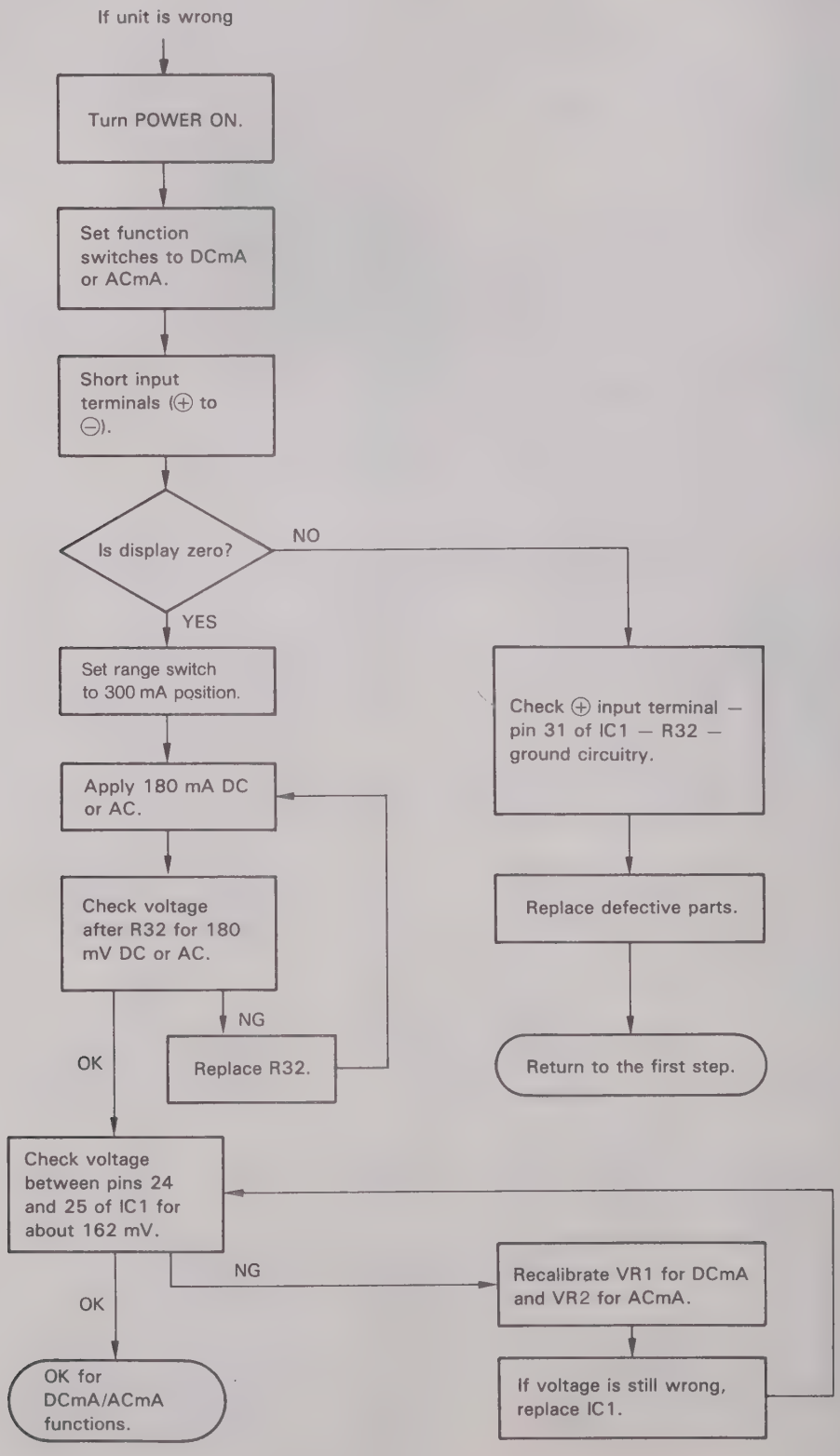
PROCEDURES:

STEP	CONTROL SETTING	CONNECTION & INPUT	ADJUST	ADJUST FOR
	Alignment of DC Current 10A Measurement Function			
4	Function Switch: DC mA Rang Switch: 10A	1) Connect DC Current Calibrator to the input 10A jack and input (-) jack. 2) Apply 10.00A DC to input.	R33	Adjust the position of the wire resistor R33 so the display reads 10.00.
	Alignment of DC Current 300mA Measurement Function			
5	Function Switch: DC mA Range Switch: 300mA	1) Connect DC Current Calibrator to input (+) jack and input (-) jack. 2) Apply 280.0 DC mA to input.		Check the display if it reads figures within spec. If not, replace R32.
	Alignment of Resistance Measurement Function			
6	Function Switch: kohm	Connect the calibration resistance (1kohm and/or 10k ohm) to the input.		Check the display if it reads figures within spec. If not, see "Troubleshooting."

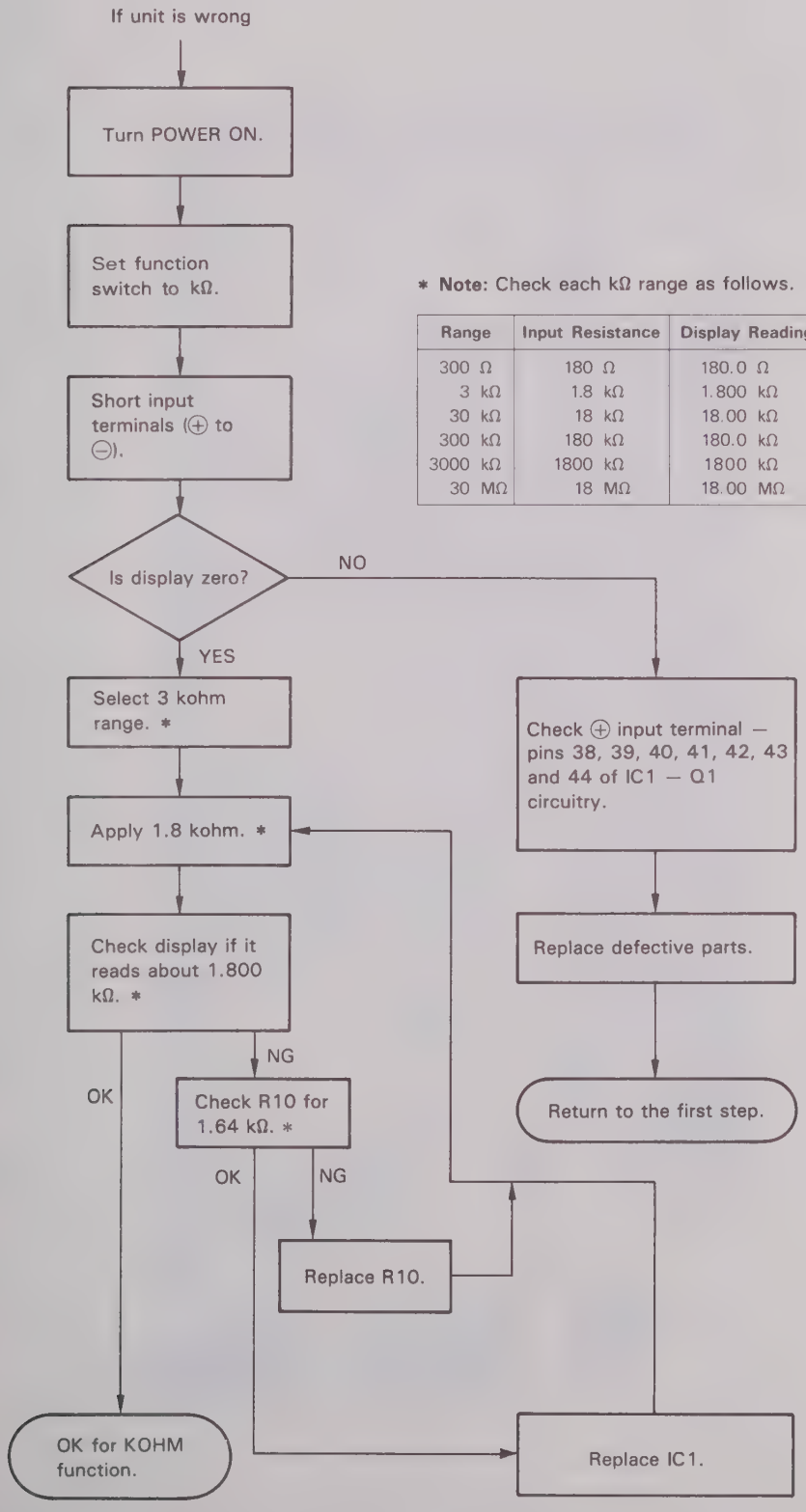
① Troubleshooting of DCV/ACV Measurement Functions


If unit is wrong
Turn POWER ON.
Set function switch to ACV or DCV.
Short input terminals (⊕ to ⊖).
Is display zero?
NO
YES
Select 30V range.
Apply 18V DC or AC.
Check display if it reads about 18.00 V.
NG
OK
Replace R1.
Check ⊕ input terminal — pin 37 of IC1 — pins 33, 34, 35 and 36 of IC1 — ground circuitry.
Replace IC1 if defective.
Return to the first step.
Check voltage between pins 24 and 25 of IC1 for about 162 mV.
NG
OK
Recalibrate VR1 for DCV and VR2 for ACV.
If voltage is still wrong, replace IC1.
OK for DCV/ACV functions.

② Troubleshooting of DCmA/ACmA Measurement Functions


If unit is wrong
Turn POWER ON.
Set function switches to DCmA or ACmA.
Short input terminals (⊕ to ⊖).
Is display zero?
NO
YES
Set range switch to 300 mA position.
Apply 180 mA DC or AC.
Check voltage after R32 for 180 mV DC or AC.
NG
OK
Replace R32.
Check ⊕ input terminal — pin 31 of IC1 — R32 — ground circuitry.
Replace defective parts.
Return to the first step.
Check voltage between pins 24 and 25 of IC1 for about 162 mV.
NG
OK
Recalibrate VR1 for DCmA and VR2 for ACmA.
If voltage is still wrong, replace IC1.
OK for DCmA/ACmA functions.

③ Troubleshooting of kohm Function

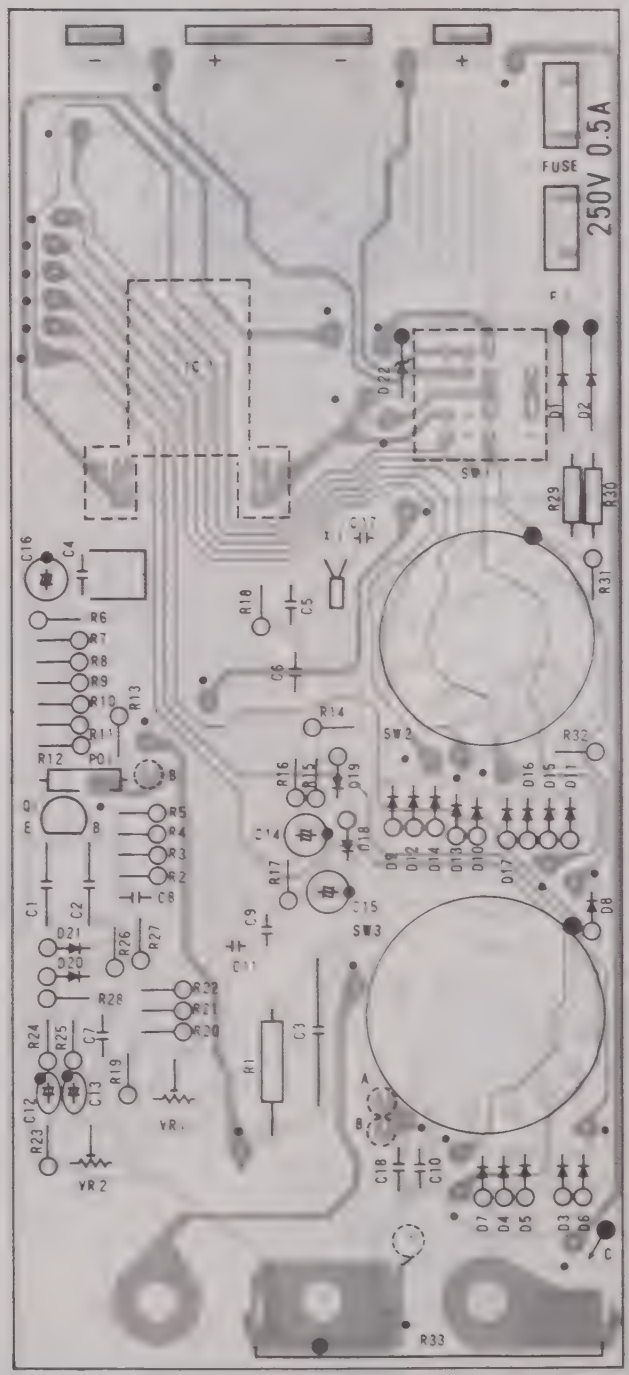

If unit is wrong
Turn POWER ON.
Set function switch to kΩ.
Short input terminals (⊕ to ⊖).
Is display zero?
NO
YES
Select 3 kohm range. *
Apply 1.8 kohm. *
Check display if it reads about 1.800 kΩ. *
NG
OK
Check R10 for 1.64 kΩ. *
OK
NG
Replace R10.
OK for KOHM function.
Check ⊕ input terminal — pins 38, 39, 40, 41, 42, 43 and 44 of IC1 — Q1 circuitry.
Replace defective parts.
Return to the first step.
Replace IC1.

* **Note:** Check each kΩ range as follows.

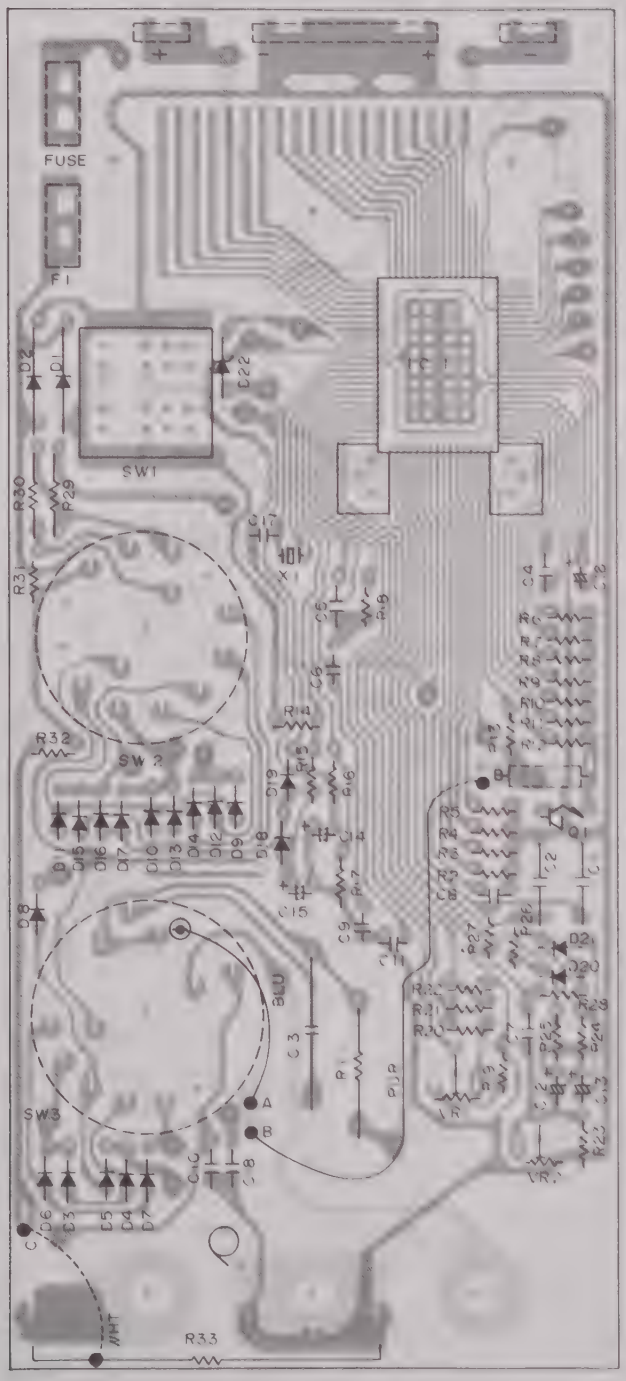
Range	Input Resistance	Display Reading	Resistors to be checked
300 Ω	180 Ω	180.0 Ω	R11 (164 Ω)
3 kΩ	1.8 kΩ	1.800 kΩ	R10 (1.64 kΩ)
30 kΩ	18 kΩ	18.00 kΩ	R 9 (16. 4 kΩ)
300 kΩ	180 kΩ	180.0 kΩ	R 8 (164 kΩ)
3000 kΩ	1800 kΩ	1800 kΩ	R 7 (1.64 MΩ)
30 MΩ	18 MΩ	18.00 MΩ	R 6 (16. 4 MΩ)

PCB DIAGRAMS (TOP AND BOTTOM VIEWS)

Top view



Bottom view



ELECTRICAL PARTS LIST

Ref. No.	Description	RS Part No.	Mfr's Part No.
CAPACITORS			
C1-2	M-Plastic 0.22µF 100V +-10% or	CC224KLBY	CFRMNA01KV or
	M-Plastic 0.22µF 100V +-10% or		CFQMN224KU or
	M-Plastic 0.22µF 100V +-10%		CFQMN224KR
C3	M-Plastic 0.022µF 1000V +-10% or	CC223KXBY	CFQMZA01KF or
	M-Plastic 0.022µF 1000V +-10%		CFQMZA02KB
C4-7	Mylar* 0.1µF 50V +-10% or	CC104KJBM	CQQSK104KV or
	0.1µF 50V +-10%		CQQBK104KF
C8-9	Mylar 0.01µF 100V +-10%	CC103KLBM	CQQMN103K*
C10	Ceramic 0.01µF 1000V+80-20% or	CC103KXBM	CKJPY103ZF or
	Ceramic 0.01µF 1000V+80-20%		CKJPY103ZV
C11	Ceramic 390pF 50V +-10%	CC391KJBC	CKJHK391K*
C12-13	Tantalum 2.2µF 16V +-20% or	CC225KDCT	CSEEG225M* or
	Tantalum 2.2µF 25V +-20% or		CSEEI225M* or
	Tantalum 2.2µF 35V +-20%		CSEEJ225M*
C14-15	Electrolytic 4.7µF 50V +-20%	CC475MJBA	CEBCK475M*
C16	Electrolytic 2.2µF 50V +-20%	CC225MJBA	CEBCK225M*
C17	Ceramic 10pF 50V +-1pF		CCJBK100F*
C18	Ceramic 0.01µF 1000V+80-20%		CKJPY103ZF or
			CKJPY103ZV
CRYSTAL			
X1	32768Hz Clock	MX1039	391011470A or
DIODES			
D1-2	Silicon 10D2 Protection or	DX0587	SDSI00002- or
	Silicon SR1K-4		SDSI00027-
D3-21	Silicon ITT73N Switching or	DX1008	SDSI00021- or
	Silicon 1N4148 or		SDSI00062- or
	Silicon 1N4148 or		SDSI00009- or
	Silicon 1N4148		SDSI00146-
D22	Zener RD7.5E Protection		SZRD7.5EB-
FUSE			
F1	250V 0.5A	HF0085	251210080A
IC			
IC1	SMC4301F0A C-MOS AC/DC Converter(Type A)	MX7142	SIS14301FA or
	or		
	SMC4301F0A C-MOS AC/DC Converter(Type B)		SIS14301FB
POSISTOR			
PO1	911x04E102YU13	RX0012	SDPS00005-
POTENTIOMETERS			
VR1	Semi-Fixed 10KB DCV CAL	P6013	177110990A
VR2	Semi-Fixed 500KB AVC CAL	P6014	177111040A

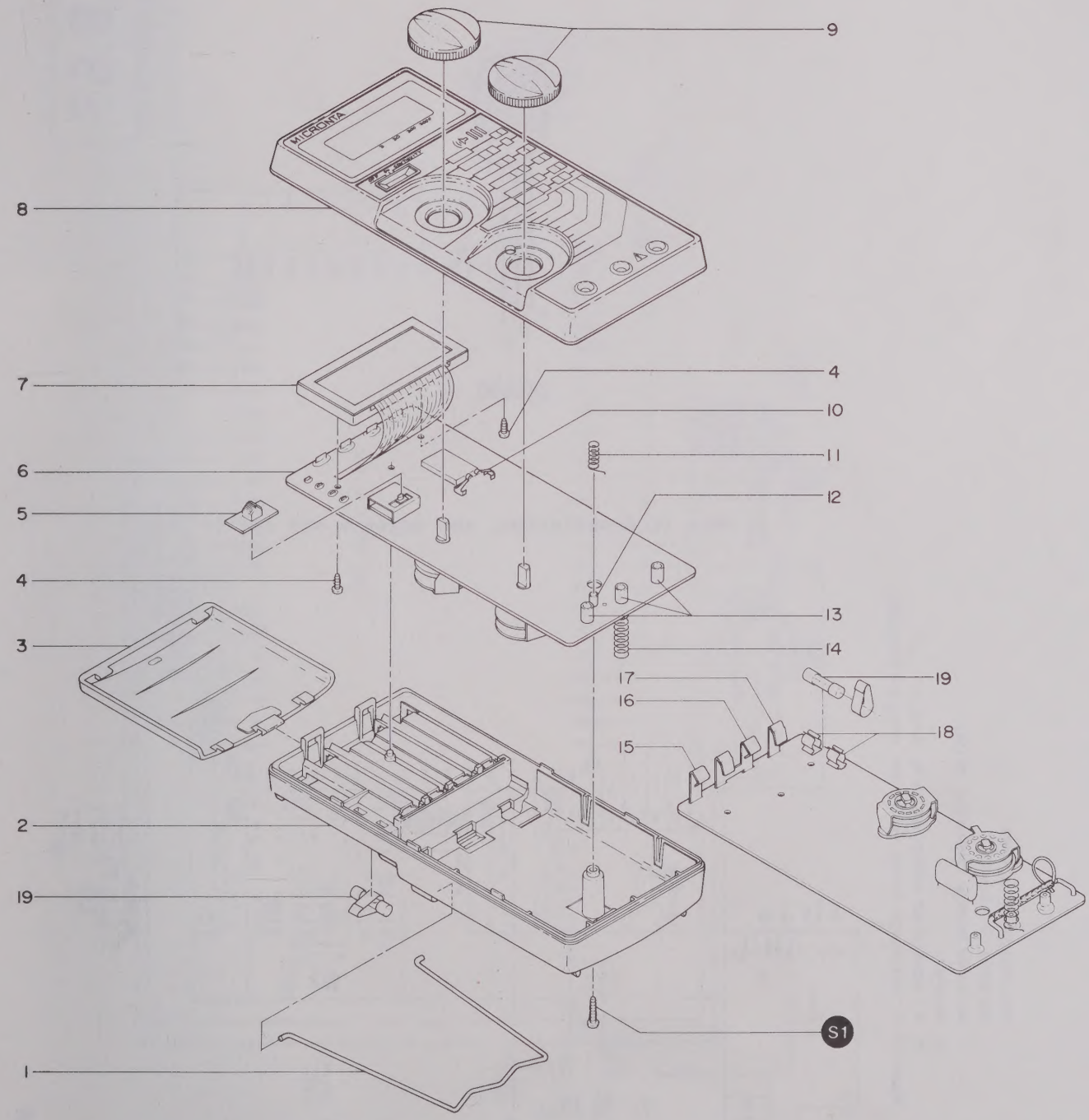
NOTE:* Mylar is a registered trademark of E. I. Du Pont de Nemours and Company.

Ref. No.	Description	RS Part No.	Mfr's Part No.
	RESISTORS		
R1	M-Film 10Mohm 1/2W +-0.5%	N0482EFE	RM0HP106D*
R2	M-Film 1.11Mohm 1/4W +-0.5%	N0579EEE	RM0QUA02D*
R3	M-Film 101kohm 1/4W +-0.5%	N0580EEE	RM0QUA01D*
R4	M-Film 10kohm 1/4W +-0.5%	N0281EEE	RM0QU103D*
R5	M-Film 1kohm 1/4W +-0.5%	N0196EEE	RM0QU102D*
R6	M-Film 16.4Mohm 1/2W +-1%	N0850BFD	RM0HPA01F*
R7	M-Film 1.64Mohm 1/4W +-1%	N0673BEE	RM0QUA01F*
R8	M-Film 164kohm 1/4W +-1%	N0674BEE	RM0QUA02F*
R9	M-Film 16.4kohm 1/4W +-1%	N0813BEE	RM0QUA03F*
R10	M-Film 1.64kohm 1/4W +-1%	N0675BEE	RM0QUA04F*
R11	M-Film 164 ohm 1/4W +-1%	N0676BEE	RM0QUA05F*
R12-13	Carbon 330kohm 1/4W +-5%	N0410EEC	RCSQU334J*
R14	M-Film 118kohm 1/4W +-1% For Cal.	N0374BEE	RM0QU754F*
	M-Film 123kohm 1/4W +-1% For Cal.		RM0QUA25F*
R15/16	M-Film 750kohm 1/4W +-1%	N0439BEE	RM0QU754F*
R17	M-Film 107kohm 1/4W +-1% For Cal.	N0372BEE	RM0QUA19F*
	M-Film 100kohm 1/4W +-1% For Cal.		RM0QU104F*
R18	M-Film 220kohm 1/4W +-1%	N0396BEE	RM0QU224F*
R19	M-Film 33kohm 1/4W +-1%	N0324BEE	RM0QU333F*
R20	M-Film 51kohm 1/4W +-1%	N0344BEE	RM0QU513F*
R21	M-Film 33kohm 1/4W +-1%	N0324BEE	RM0QU333F*
R22	M-Film 5kohm 1/4W +-1%	N0251BEE	RM0QU502F*
R23	M-Film 27kohm 1/4W +-1%	N0316BEE	RM0QU273F*
R24-25	M-Film 22kohm 1/4W +-1%	N0311BEE	RM0QU223F*
R26-27	M-Film 330kohm 1/4W +-1%	N0410BEE	RM0QU334F*
R28	M-Film 22Mohm 1/2W +-1%	N0585BEE	RM0HP226F*
R29	M-Film 10kohm 1/4W +-1%	N0281BEE	RM0QP103F*
R30	M-Film 90 ohm 1/4W +-1%	N0127BFE	RM0QP900F*
R31	M-Film 9 ohm 1/4W +-1%	N0060BEE	RM0QU9R0F*
R32	M-Film 0.93 ohm 1/4W +-1% For Cal.	N0856BEE	RM0QUR93F*
	M-Film 0.94 ohm 1/4W +-1% For Cal.	N0537BEE	RM0QUR94F*
R33	Wire Resistor, D1.6 MANGANIN	W3203	W5A1R6MT-Y
	SWITCHES		
SW1	Slide 4C-3P Power	S3607	183111520A
SW2	Rotary 2C-6P Range	S3606	181110210B
SW3	Rotary 2C-6P Function	S3605	181110220A
	TRANSISTOR		
Q1	2SD400(E) NPN Protection or 2SD400(F)	2SD400F	ST2D400--E or ST2D400--F

EXPLODED VIEW PARTS LIST

Ref. No.	Description	RS Part No.	Mfr's Part No.
1	Handle	H6043	714010120A
2	Bottom Cabinet Ass'y	Z1398	M-00715
	Cabinet, Bottom		601311460A
	Sheet, Shield		473311030A
	Contact, Battery, for Bottom Cabinet		198110870A
	Label, Warning US		733310820A
	Label, Warning CA		733310840A
	Label, Warning AU/UK/BG		733310830A
3	Cover, Battery	DB0729	602110610A
4	Screw, Taptite, 2.3X5BT-B, for Holder		HCBB2305SY
5	Knob, for Power	K0996	659010070A
6	PCB Unit, Main	XB1527	U-25584
7	LCD, Ass'y		M-00717
	Wire, Flat, LCD to Main PCB	W3517	317010910A
	LCD, LD-B7160A	L2063	553510100A
	Cushion, for Holder		851011830A
	Holder, for LCD		413101360A
8	Top Cabinet Ass'y	Z1396	M-00713
	Cabinet, Top		601211650A
	Plate, Range		711610140A
	Window		713510490A
	Sheet, Shield		473311020A
	Buzzer	B7110	272010010A
9	Knob Ass'y	K0997	M-00714
	Knob, Function Selection		652110080A
	Cam		436110110A
10	Switch, Contact, C5210R, PCB. Buzzer	S3608	180810190A
11	Spring, Coil, Small	RB6908	434110450A
12	Shaft, for Small Spring	RT3343	416210240A
13	Terminal, Tester, for Test Lead	J5927	194510110A
14	Spring, Coil, Large	RB9439	434110440A
15	Contact, Battery, PCB (-)	B0994	198110850A
16	Contact, Battery, PCB (+-)	B0995	198110860A
17	Contact, Battery, PCB (+)	B0993	198110840A
18	Clip, Fuse	F1409	197303320C
19	Fuse, 250V 0.5A	HF0085	251210080A
	Hardware Kit	HW2200185	HWK2200185
	Screw, Taptite, 3x12PT-B, for Bottom Cabinet		HCPB3012SY
	Lead, Test	W3417	315010012B

EXPLODED VIEW/DISASSEMBLY



Ref. No.	Description
S1	Taptite, 3x12PT-B, Bottom Cabinet

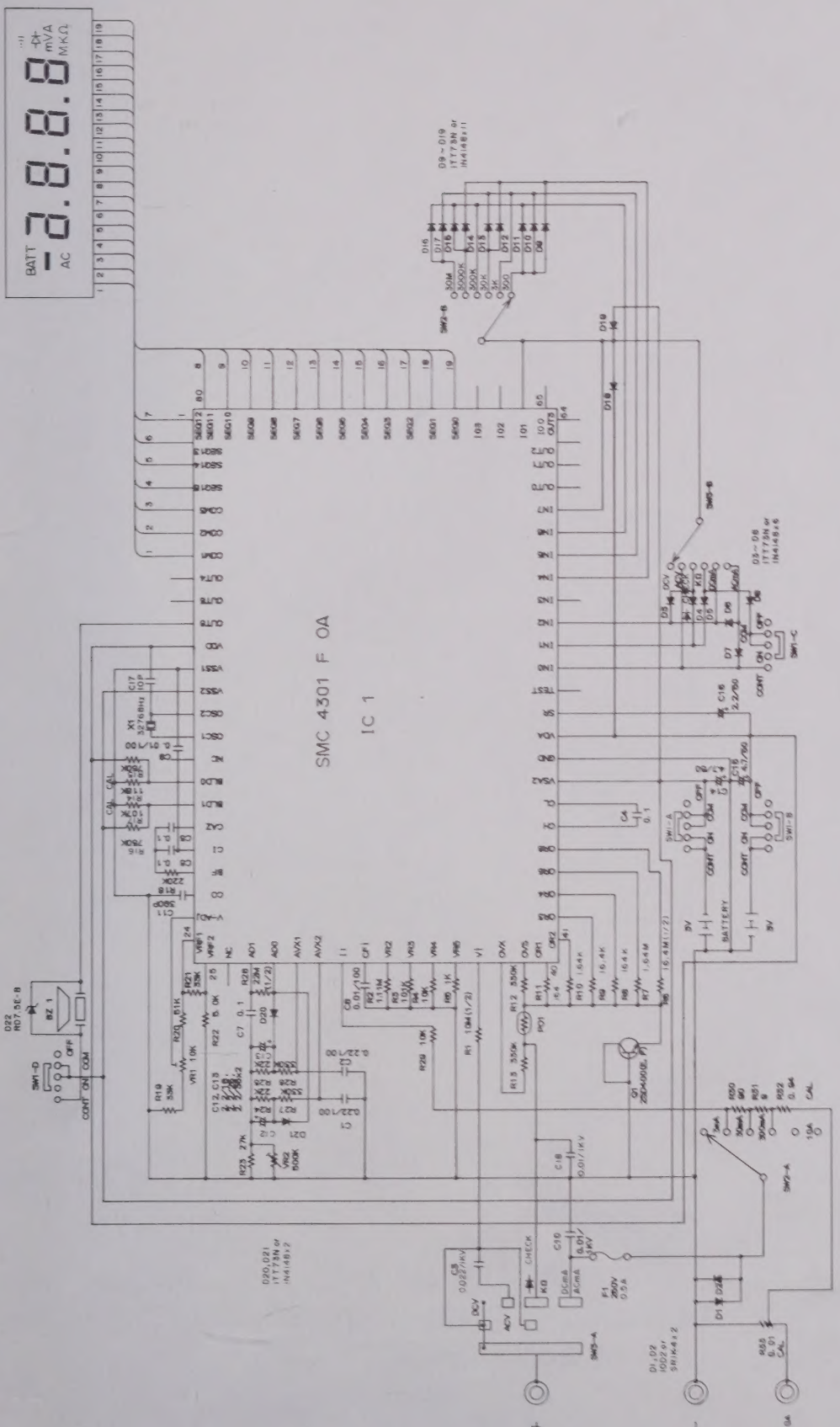
DISASSEMBLY INSTRUCTIONS:

1. Remove 2 knobs (9).
2. Remove a screw (S1).

TRANSISTOR LEAD INDENTIFICATION

2SD400

*For IC description, see pages 6 and 7.


BATT
AC
-2.8.8.8
mV
MΩ
SMC 4301 F OA
IC 1
NOTES: (1) ALL RESISTANCE VALUES ARE IN OHM (K=10³ OHM, M=10⁶ OHM).
(2) ALL CAPACITANCE VALUES ARE IN μF (P=10⁻⁶ μF).
(3) SWITCHES:
SW1; POWER SW WITH CONTINUITY (SLIDE)
SW2; RANGE SW (ROTARY)
SW3; FUNCTION SW (ROTARY)

RADIO SHACK
A Division of Tandy Corporation
Fort Worth, Texas 76102

10A6

Printed in Taiwan
811112060A